Elk Habitat Management in Montana W-179-R

Annual interim report, August 2021

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Executive Summary

The Elk Habitat Management in Montana project was initiated to gather information on seasonal habitat use and movements of elk and to evaluate the importance of hunter access management in determining elk distributions during the hunting season. This work will be implemented across the Devil's Kitchen study area in central Montana and the Custer and Missouri Breaks study areas in eastern Montana. Data collection and monitoring efforts are currently underway and on track in the Devil's Kitchen and Custer areas, with plans to initiate data collection in the Missouri Breaks area in 2022.

The primary objectives during this reporting period were to capture, sample, and collar elk to maintain a sample of 60 adult females in the Devil's Kitchen area and initiate elk location data collection in the Custer area. We captured and instrumented 15 adult female elk with satellite collars in the Devil's Kitchen area from 2/10/2021 to 2/11/2021, increasing the sample of collared elk to a total of 65 individuals. From 1/27/2021 to 2/1/2021, we captured and instrumented 40 adult female and 20 adult male elk in the Custer study area south of Ashland and west of Broadus, MT. In both locations, captured individuals were outfitted with Lotek LiteTrack 420 satellite collars programmed to collect hourly location data. We removed a tooth from captured females to age individuals via cementum annuli and we used antler growth and tooth wear patterns to estimate the age of adult males. Fecal pellets were collected in the Custer study area to determine seasonal dietary preferences of prairie elk populations and inform habitat management recommendations. For captured females in both locations, we assessed rump fat thickness from ultrasonography and chest girth measurements, estimated a body condition score based on manual inspection of the spine and hips to estimate fat deposits, and collected blood samples for pregnancy testing and disease screening following MFWP Wildlife Health Program protocols.

In the Devil's Kitchen study area, blood samples from all 15 captured females in 2021 were submitted for pregnancy testing and screened for exposure to *Brucela abortus*. Pregnancy testing classified 13 of these individuals as pregnant, matching the state-wide average adult pregnancy rate of 87%. We found no serological evidence of exposure to *Brucela abortus*.

In the Custer study area, blood samples from 39 captured females were available for pregnancy testing and screening for a suite of wildlife diseases. Of those individuals submitted for pregnancy testing, 5 were yearlings and not classified as pregnant. Pregnancy testing classified 18 of the 34 adult female samples submitted as pregnant (53%), well below the state-wide average adult pregnancy rate of 87%. We found no serological evidence of exposure to *Brucela abortus*, Leptospirosis, bovine respiratory syncytial virus, or bovine viral diarrhea type 1. We did find evidence of exposure to Anaplasma bacteria (72% seroprevalence), Parainfluenza-3 (82% seroprevalence), Bovine viral diarrhea virus type 2 (3% seroprevalence),

and Epizootic hemorrhagic disease (62% seroprevalence; Table 1). Exposure to these pathogens is not expected to have a negative influence on herd health.

As of August 1, 2021, we have collected a total of 572,385 locations from 65 collared females in the Devil's Kitchen area. We are currently monitoring 53 individuals; 9 mortalities and 3 collar failures have occurred. In the Custer area, we have collected 188,013 locations from 60 collared individuals. We are currently monitoring 40 female and 20 male elk; no mortalities or collar failures have occurred. Movement information collected in both areas has been compiled and shared on a monthly basis with state and federal agency partners, local landowners, and the general public.

Project Background

Recently, there has been a focus in the western United States to identify and conserve big game migration corridors and winter ranges, as highlighted in the 2018 Department of Interior Secretarial Order 3362. Seasonal range and movement information is lacking for many elk populations in Montana, particularly in the central and eastern portion of the State. As part of a Montana Fish, Wildlife and Parks (MFWP) initiative to identify elk migration corridors and winter ranges and work cooperatively with partners to conserve these important habitats, there is a need to collect and assess elk movement data. The purpose of this project is to identify seasonal ranges and movement corridors for the Devil's Kitchen, Custer, and Missouri Breaks elk populations in central and eastern Montana (Figure 1), evaluate the effects of hunter access management and other landscape features on habitat selection in these populations, and provide information to enhance elk management in prairie regions.

Our first goal is to delineate migration corridors and seasonal ranges of three elk populations in central and eastern Montana including the Devil's Kitchen, Custer Forest, and Missouri Breaks populations. These areas have been selected based on the local needs identified by MFWP management biologists, and where considerable community, conservation partner, and agency interest in elk habitat conservation exists. A standardized and comprehensive assessment of movement data will ensure seasonal ranges and movement corridors are appropriately quantified, facilitate comparisons among populations, and result in a comprehensive communication tool that FWP can use to inform local stakeholders and agency partners as they consider ways to improve elk habitat in land use and planning decisions.

This component of the project involves collecting elk location data from GPS-collared elk in the three study areas for three years (Figure 1). We have developed methodologies for delineating seasonal ranges and corridors in collaboration with the USGS corridor mapping team and scientists in other State Agencies utilizing Brownian bridge and kernel-based movement models. We will estimate seasonal core use areas during winter (Dec 15 – March 1), calving/fawning (May 25-June 10), summer (July 1 – August 31), and hunting seasons (approx. Sept 1 – Nov 30), and summarize the attributes of seasonal ranges. We will identify important movement corridors by estimating population-level migration routes (e.g., Horne et al. 2007,

Kranstauber et al. 2012, Thurfjell et al. 2014, Avgar et al. 2016). Movement-based models are useful for mapping population-level movement corridors and identifying corridors with the highest levels of use. Summaries and maps of location and movement data will be presented in documents designed for landowners and managers that are intended for use in local decision making.

We anticipate that fine-scale location data collected in the Devil's Kitchen study area will help to identify important seasonal habitats and movement corridors and provide information regarding the timing of movements. This information may then be used to refine harvest management strategies that maximize the effectiveness of elk management in the area. Landowners, MFWP, and community members are presently engaged in a longstanding community working group (Devil's Kitchen Working Group) that regularly meets to discuss elk management in the area. The results of this study will aid these conversations on elk management and facilitate stronger conservation-oriented discussions. We anticipate that fine-scale location data collected in the Custer Forest and Missouri Breaks will also provide new information to inform management aimed at achieving more desirable distributions and harvest.

Our second goal is to broadly evaluate factors such as habitat quality, security, and hunter access to evaluate and compare attributes of problematic and non-problematic elk distributions. We define problematic elk distributions as elk distributions during the fall and winter hunting seasons that result in failure to achieve female harvest objectives. While it is generally understood that existing problematic elk distributions may be driven by harvest regulations, restrictive hunter access management, landscape factors, or a combination of these factors, a formal assessment is necessary to assess whether elk herds that are or are not characterized by problematic distributions differ among these drivers. This will involve summary analyses of existing data from populations across the state.

To address our second goal, we will combine and analyze existing elk GPS collar data at a statewide scale to broadly evaluate factors associated with problematic elk distributions. Currently, the degree to which elk populations are over objective is hypothesized to relate to the amount of lands with restrictive hunter access; however, this hypothesis has not been broadly evaluated, and other landscape attributes may also influence problematic distributions. We plan to utilize a resource selection modeling approach to evaluate how the strength of elk selection for private lands with restricted hunter access varies across populations. We plan to relate the amount of lands with restrictive access and selection coefficients to the degree elk populations exceed objective levels to test the hypotheses that hunter access management and/or elk selection behaviors are associated with the degree to which populations are over objective.

Our third goal is to evaluate the effects of hunter access management and other important factors on elk habitat selection in the Devils Kitchen, Custer Forest, and Missouri Breaks areas, particularly during the fall hunting seasons. We will use location data collected from GPS collared elk in the Devils Kitchen, Custer Forest and Missouri Breaks study areas to evaluate elk

habitat selection. Lands with restrictive hunter access may serve as refuges, and elk may aggregate in these areas to escape harvest risk during the hunting seasons (Conner et al. 2001, Vieira et al. 2003, Proffitt et al. 2013). If factors such as security, forage and hunter access can be identified and related to habitat selection, managers may use this information to design management plans to manipulate these factors and increase the amount of time elk spend on public land, furthering opportunity for hunters using public lands and reducing game damage incurred on adjacent private lands. By increasing our understanding of these central Montana and prairie elk populations, FWP will be better able to sustainably provide harvest opportunity, minimize game damage and problematic distributions, and work with private and public land stewards to manage habitat that benefits elk.

MFWP and partners have invested considerable resources in evaluating the effect of factors such as hunter access management and elk security on elk distributions in the mountains and forested landscape of western Montana (Ranglack et al. 2017, DeVoe et al. 2019, Lowrey et al. 2020). However, no such studies have been conducted in central Montana and only one study has evaluated factors affecting elk distributions during the hunting season in prairie environments (Proffitt et al. 2016). This lack of information creates a challenge for wildlife managers in central Montana and the prairie regions. To address our third goal, we will build from previous security habitat studies in Montana and provide information and recommendations as to population and habitat management strategies for elk in central Montana and the prairie environments of eastern Montana following a similar approach (Proffitt et al. 2013, 2016, DeVoe et al. 2019, Lowrey et al. 2020).

Information gained from this project will be used for on-the-ground implementation by FWP and partners to manage, protect, and improve important elk habitats and develop strategies to manage elk populations at desired abundances and distributions. Implementation may include working with public and private landowners to improve security and/or habitat quality, remove barriers impeding movement, or may include recommendations for hunter access management.

We began addressing the first of our goals during this reporting period and plan to begin work on our second and third goals during the next reporting period.

Our objectives during this reporting period were:

1. Capture, sample, and collar up to 25 elk in the Devil's Kitchen area and 60 elk (20 males, 40 females) in the Custer study area.
2. Continue elk location data collection in the Devil's Kitchen area and initiate location data collection in the Custer study area.

Location

This research will be conducted in portions of Cascade, Lewis and Clark, Garfield, Powder River, Bighorn, and Rosebud River Counties (Figure 1). The Devil's Kitchen elk population occupies Lewis and Clark and Cascade Counties and spans portions of hunting districts (HD) 445, 455 and 446. There are approximately 4,000 elk distributed across several winter ranges.

The Custer elk population occupies Powder River, Bighorn, and Rosebud Counties and spans portions of HD 704 and 705. This elk population has grown to approximately 1,700 elk since surveys began in 2005. The annual range includes a mixture of privately-owned ranchlands, sagebrush and mixed-grass prairies, and xeric, ponderosa pine (*Pinus ponderosa)* dominated forest communities.

The eastern Missouri Breaks population occupies Garfield County and is within HD 700. In the last three surveys conducted during the last six years, the population count ranged from 800 to 1,500 elk. During the most recent survey conducted in winter 2020, a total of 1,300 elk were counted. Survey data suggests the elk population is 500-1200 individuals above the population objective of 200-300 individuals. The annual range includes a mixture of privately-owned ranchlands and sagebrush, mixed-grass prairies, and ponderosa pine forest communities.

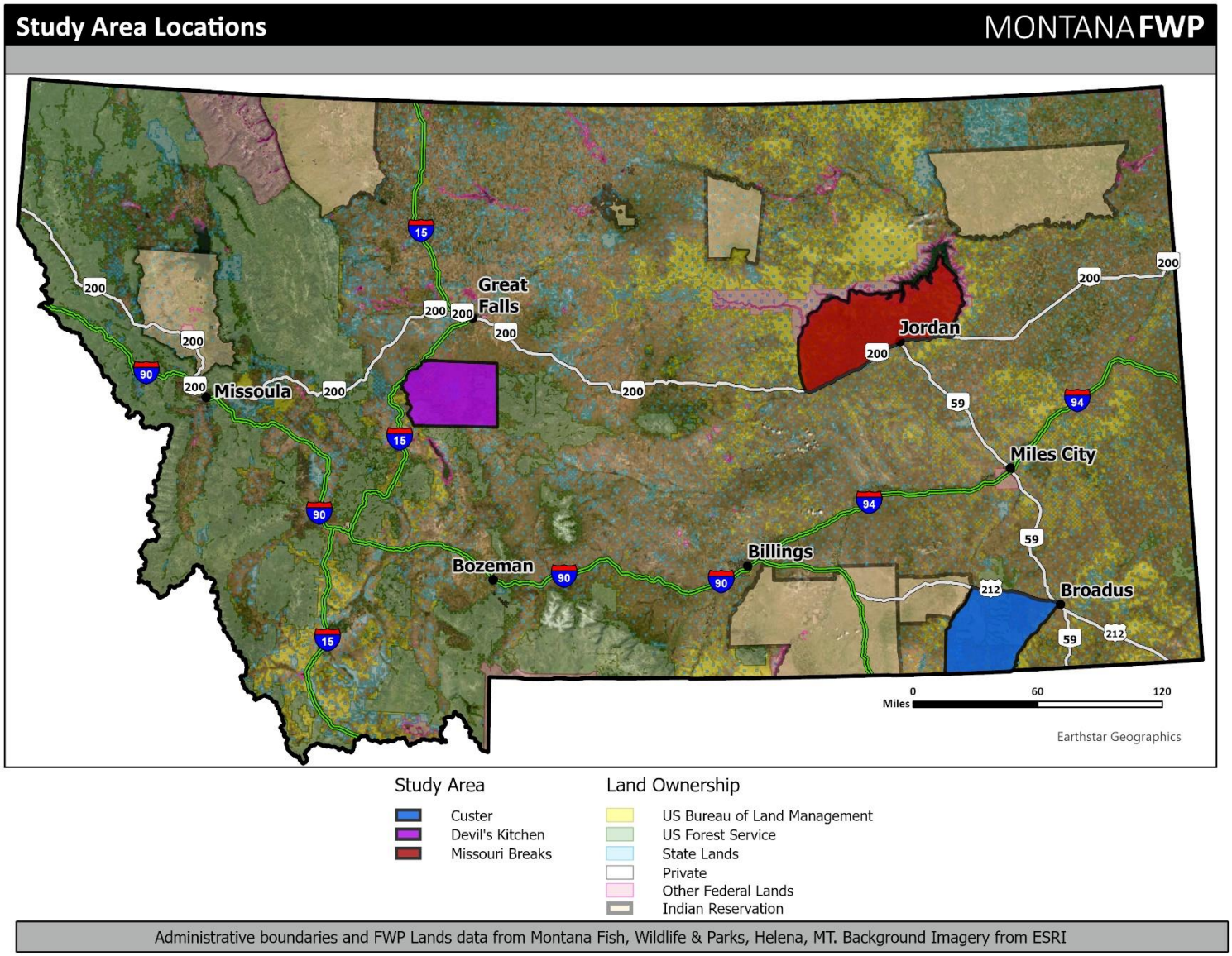

Figure 1. The Devil's Kitchen, Custer Forest, and Missouri Breaks study areas in central and eastern Montana.

Objective 1: Capture, sample, and collar up to 25 elk in the Devil's Kitchen area and 60 elk (20 males, 40 females) in the Custer study area.

1.1 Devil's Kitchen elk capture, sampling, and collaring

We used helicopter net-gunning to capture and collar a total of 15 female elk in the Devil's Kitchen study area from February 10, 2021 to February 11, 2021 (Figure 2) to augment a sample of previously collared animals in the study area. A total of 65 animals have been collared in the Devil's Kitchen study area to date. We outfitted captured individuals with Lotek LiteTrack Iridium collars programmed to collect hourly locations for two years. The collars were programmed to transmit a VHF signal during daylight hours and switch to a mortality signal if stationary for >10 hours. Collars upload locations via Iridium satellites to a web platform where data can be viewed and downloaded in near-real-time. For each captured female, we pulled a tooth for aging purposes via cementum annuli, collected a blood serum sample for pregnancy testing and to test for exposure to *Brucella abortus*, estimated a body condition score, and obtained a measurement of rump fat thickness via ultrasound. We are awaiting age results but provide an overview of pregnancy, serology, and body condition results below.

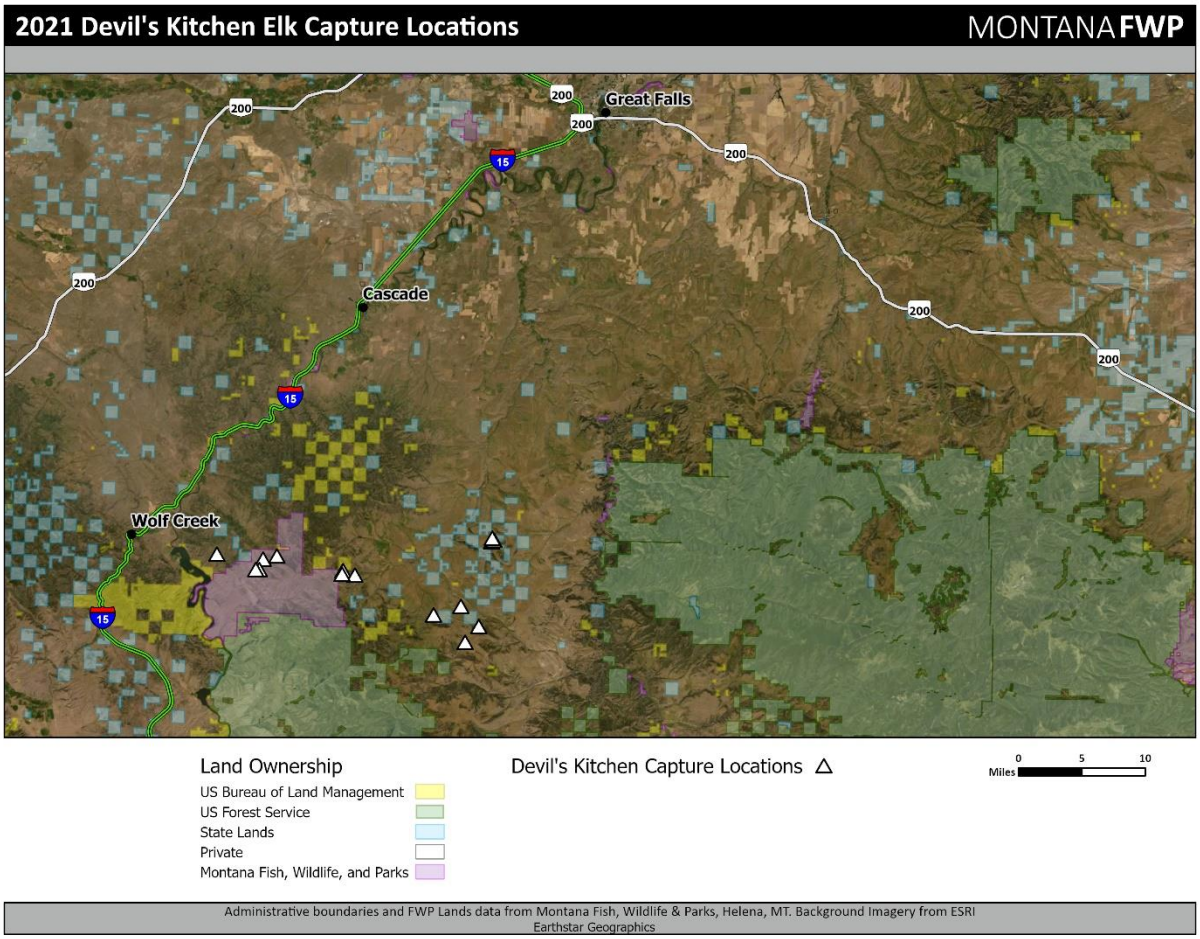

Figure 2. Capture locations for the 15 female elk captured and collared in the Devil's Kitchen study area in 2021. Captures took place on the Beartooth Wildlife Management Area, Helena National Forest, state, and private lands south of Great Falls, MT.

1.1.1 Devil's Kitchen Sampling Results

1.1.1.1 Pregnancy

Blood serum samples can be used to detect levels of pregnancy-specific protein B (PSPB; a pregnancy-specific protein which is released in higher quantities when a fetus is present) in a variety of wild ungulates to determine pregnancy status (Wood et al. 1986, White et al. 1995, Noyes et al. 1997, Huang et al. 2000, Drew et al. 2001). We sent blood serum samples from 15 captured females to be tested for PSPB (Herd Health Diagnostics/BioTracking Testing Lab, Pullman, Washington). PSPB values were classified into categories that are typical for wildlife species: open (values ≤ 0.210) and pregnant (values > 0.210). PSPB levels (measured as an optical density) in the Devil's Kitchen study area averaged 0.4297 (SD = 0.146; range = 0.050 – 0.510). Of the 15 females whose blood serum was sent for PSPB testing, 13 were classified as pregnant. The percentage of pregnant adults (n=15) in the Devil's Kitchen study area was 87%, matching the state-wide average.

1.1.1.2 Serology

A full serology screening was completed in the Devils Kitchen study area during previous capture efforts in February 2020, when 50 adult female elk were collared and sampled. We did not find any concerning disease exposure during this initial round of screening, and blood serum samples collected from 15 adult female elk in the Devil's Kitchen area in February 2021 were only assayed for evidence of exposure to the *Brucella abortus* pathogen by the Montana Veterinary Diagnostic Laboratory (MVDL; Bozeman, Montana). We found no serological evidence of exposure to *B. abortus* in the Devil's Kitchen study area.

1.1.1.3 Body Condition

We estimated a body condition score for 15 females in the Devil's Kitchen area based on manual inspection of the spine and hips to estimate fat deposits. Body condition scores can range from one (very poor) to five (very high). We also measured the maximum rump fat thickness in centimeters (Maxfat) of these 15 females using a portable ultrasound. The average body condition score was 4 (range: 3.5 - 4.5); higher than the state-wide average of 3.51. Maxfat measurements averaged 0.58 cm (range: 0.3 - 0.96), coming in under the state-wide average of 0.74 cm. Using well-established relationships (Cook et al. 2010, Cook et al. 2013), we also estimated the percent ingesta-free body fat (IFBF). The average IFBF value for the 15 females sampled in 2021 was 7.41%, similar to the state-wide average of 7.80% (Figure 3).

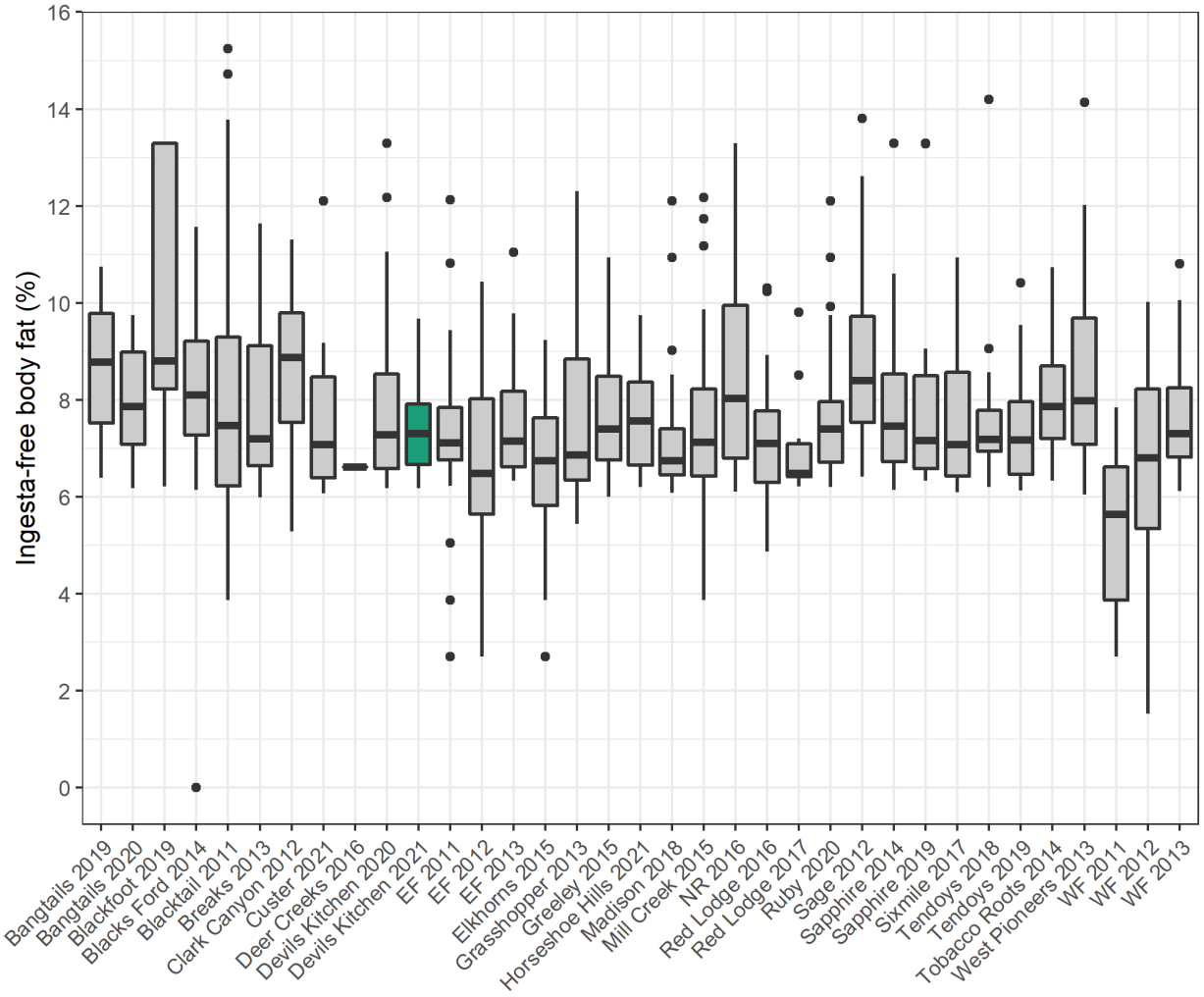

Figure 3. Estimated ingesta-free body fat percentage (IFBF) for the Devil's Kitchen study area (green) relative to IFBF estimates from herds across the state (grey).

1.2 Custer elk capture, sampling, and collaring

We used a combination of aerial darting and helicopter net-gunning to capture and collar a total of 40 female and 20 male elk in the Custer study area from January 27, 2021 to February 1, 2021 (Figure 6). We outfitted captured individuals with Lotek LiteTrack Iridium collars programmed to collect hourly locations for three years. The collars were programmed to transmit a VHF signal during daylight hours and switch to a mortality signal if stationary for >10 hours. Collars upload locations via Iridium satellites to a web platform where data can be viewed and downloaded in near-real-time. During captures, we obtained blood serum samples from 39 captured females and submitted these samples for a full serology screening and pregnancy testing. For each captured female, we pulled a tooth for aging purposes via cementum annuli, estimated a body condition score, obtained a fecal pellet sample for dietary analysis, and obtained a measurement of rump fat thickness via ultrasound. We are awaiting age and dietary analysis results but provide an overview of pregnancy, serology, and body condition results below.

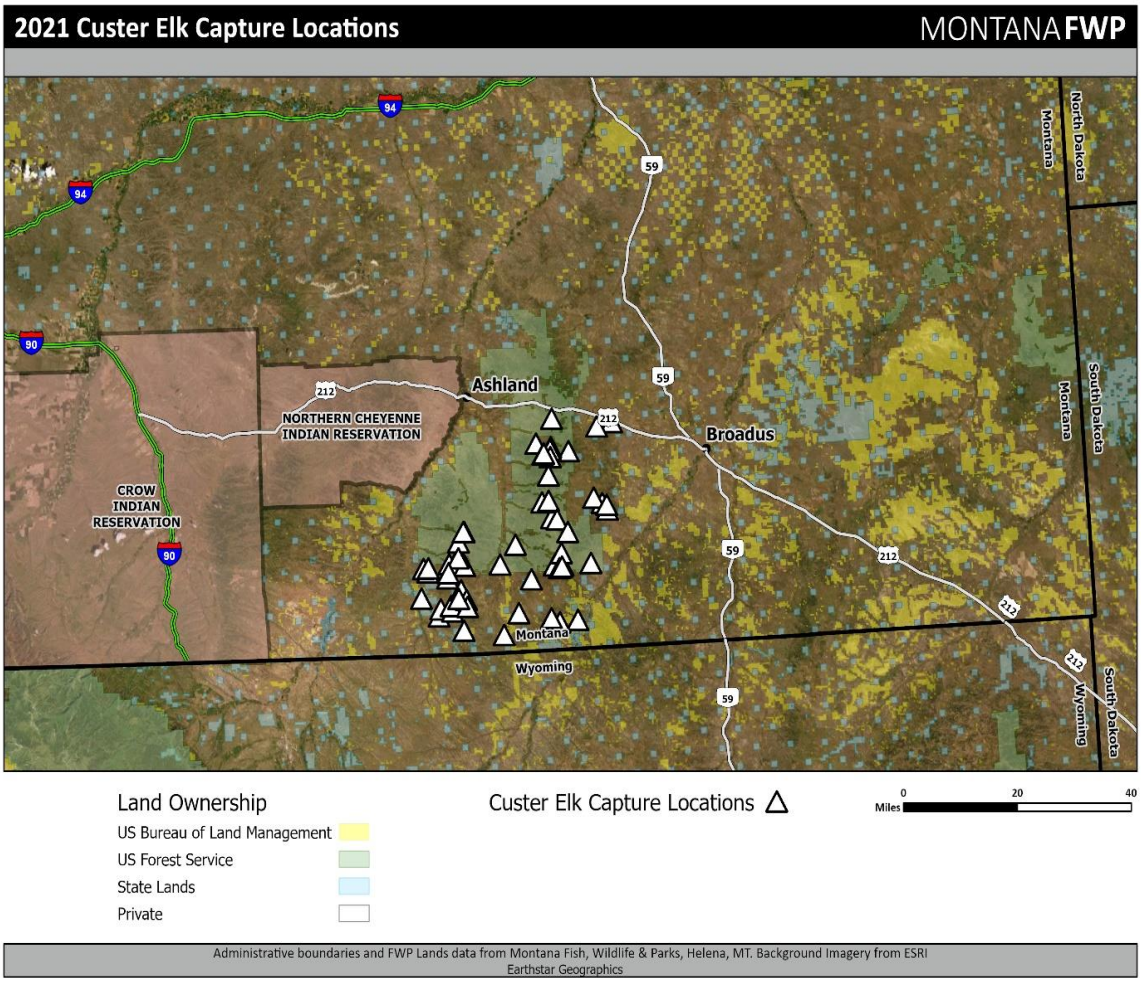

Figure 6. Capture locations for the 20 male and 40 female elk captured and collared in the Custer study area in 2021. Captures took place on the Custer National Forest and surrounding BLM, state, and private lands south of Highway 212 and west of Broadus, MT.

1.2.1 Custer Sampling Results

1.2.1.1 Pregnancy

Blood serum samples can be used to detect levels of pregnancy-specific protein B (PSPB; a pregnancy-specific protein which is released in higher quantities when a fetus is present) in a variety of wild ungulates to determine pregnancy status (Wood et al. 1986, White et al. 1995, Noyes et al. 1997, Huang et al. 2000, Drew et al. 2001). We sent blood serum samples from 39 captured females to be tested for PSPB (Herd Health Diagnostics/BioTracking Testing Lab, Pullman, Washington). PSPB values were classified into categories that are typical for wildlife species: open (values ≤ 0.210) and pregnant (values > 0.210). PSPB levels (measured as an optical density) in the Custer study area averaged 0.244 (SD = 0.210; range = 0.045 – 0.528). Of the 39 females whose blood serum was sent for PSPB testing, 18 were classified as pregnant. Five of those tested were yearlings, none of which were pregnant. The percentage of pregnant adults (n=34) in the Custer study area was 53%; well-below the state-wide average of 87%.

1.2.1.2 Serology

Blood serum samples from 39 adult female elk were assayed for evidence of exposure to pathogens including *Brucella abortus*, Anaplasma bacteria, Leptospirosis, parainfluenza-3 (PI-3), bovine respiratory syncytial virus (BRSV), bovine viral diarrhea type 1, bovine viral diarrhea type 2 (BVD I and II), bovine herpesvirus-1 (BHV-1), and epizootic hemorrhagic disease. These pathogens were selected for screening because of their potential to influence individual or herd health in wildlife and/or livestock. All assays were conducted by the Montana Veterinary Diagnostic Laboratory (MVDL; Bozeman, Montana) except for EHD which was conducted by National Veterinary Services Laboratories (NVSL; Ames, Iowa). Evidence for exposure varied by pathogen (Table 1). We found no serological evidence of exposure to *B. abortus*, leptospirosis, BRSV, or BHV-1. We did find evidence of exposure to Anaplasma (72% seroprevalence), PI-3 (82% seroprevalence), BVD II (3% seroprevalence), and EHD (62% seroprevalence). A brief description of each detected pathogen and its influence (if known) on individual and herd health can be found below.

Statistic	BRUC	ANAPL	LEPTO	PI3	BRSV	BVD 1	BVD 2	BHV-1	EHD
# Sampled	39	39	39	39	39	39	39	39	39
# Exposed	0	28	0	32	0	0	1	0	24
% Exposed	0	72	0	82	0	0	3	0	62

Table 1. Seroprevalence of brucellosis (BRUC), anaplasmosis (ANAPL), leptospirosis (LEPTO), parainfluenza-3 (PI3), bovine respiratory syncytial virus (BRSV), bovine viral diarrhea type 1 (BVD 1), bovine viral diarrhea type 2 (BVD 2), bovine herpesvirus-1 (BHV-1), and epizootic hemorrhagic disease (EHD) based on serological screening of adult female elk in the Ashland study area during the winter of 2021.

Anaplasmosis
Anaplasmosis, a sickness caused by bacteria of the genus *Anaplasmaisa*, is a vector-borne disease primarily affecting domestic cattle. *Anaplasma marginale*, the species most involved with infections in cattle, affects red blood cells resulting in severe anemia and sometimes death. Elk are susceptible to Anaplasma infection. However, serious clinical signs have not been recorded and there is little evidence suggesting elk are important carriers or reservoirs of the disease (Kuttler 1984; Zaugg et al. 1996). We found serological evidence of exposure to Anaplasmosis in 72% of female elk sampled in the Ashland study area, though the specific Anaplasma species the elk were exposed to are unknown, because the test detects antibodies for multiple species. This pathogen is not expected to impact individual or herd health in elk.

Parainfluenza-3
Parainfluenza-3 is a common virus that can be involved in respiratory disease in domestic ungulates. The disease associated with PI-3 is usually mild or subclinical, but under severe stress, the virus may predispose animals to coinfection with other respiratory pathogens resulting in development of secondary bacterial pneumonia. It is unknown whether exposure to this virus leads to clinical symptoms in free-ranging elk (Barber-Meyer et al. 2007). Evidence of exposure on serological testing is common in wildlife but documented clinical cases of disease are not. We found a seroprevalence of 82% in female elk sampled in the Ashland study area; however, exposure to this virus is not expected to impact individual or herd health.

Bovine viral diarrhea (types 1 & 2)
Bovine viral diarrhea virus (types 1 & 2) can cause bloody diarrhea and can induce immunosuppression resulting in development of secondary bacterial pneumonia in domestic and wild ungulates. The different types (1 & 2) reflect differences in the antigens found on the viral surface protein and do not relate to the virulence of the virus. Elk are susceptible to infection with BVD, but there is little evidence of serious clinical effects (Tessaro et al. 1999). There is potential for wildlife populations to serve as reservoirs of this virus (Duncan et al. 2008). We found no serological evidence of exposure to BVD type 1 but did find that 1 sampled female had an antibody titer to BVD type 2.

Epizootic hemorrhagic disease
Epizootic hemorrhagic disease (EHD) is caused by a virus that is transmitted by biting midges in the *Culicoides* genus and other arthropods. EHD can cause acute and frequently fatal hemorrhagic disease in domestic and wild ungulates. Recurrent outbreaks of EHD-associated mortality occur in white-tailed deer and mule deer, primarily in eastern Montana (Montana Fish, Wildlife and Parks Wildlife Health Lab, unpublished data). Elk are susceptible to epizootic hemorrhagic disease, but generally do not suffer high rates of mortality or show clinical symptoms (Hoff 1973; Nol et al. 2010). Epizootic hemorrhagic disease virus exposure was detected in 62% of sampled female elk in the Ashland study area. There is some concern that elk could act as reservoirs of EHD, allowing the vectors (biting midges) to transmit the virus to other

wildlife during the right environmental conditions (Thorne et al. 2002), but such relationships are not well studied.

2.1.1.3 Body Condition

We estimated a body condition score and measured maximum rump fat thickness in centimeters (Maxfat) for 36 females in the Custer area. The average body condition score was 3.79 (range: 3.5 -4.6). This average is slightly higher than the state-wide average of 3.51. Maxfat measurements averaged 0.54 cm (range: 0.26 - 1.13), coming in under the state-wide average of 0.74 cm. The average IFBF value for the 36 sampled females in the Custer study area was 7.48%, similar to the state-wide average of 7.80% (Figure 7). Body condition data indicated that pregnant individuals tended to have higher maxfat values than those that were not pregnant (Figure 8). However, we did not find a relationship between pregnancy status and IFBF value in the Custer population (Figure 9).

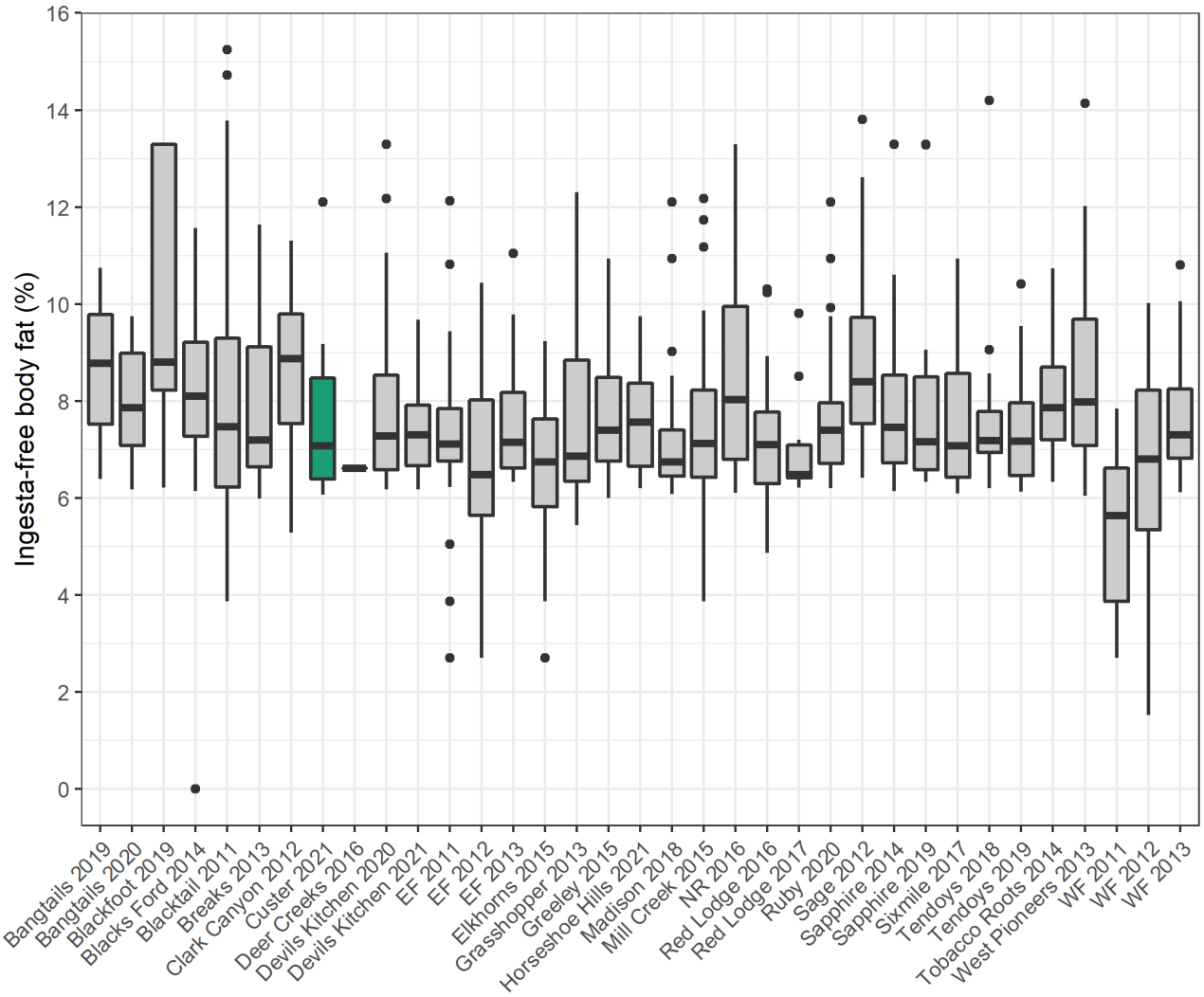

Figure 7. Estimated ingesta-free body fat percentage (IFBF) for the Custer study area (green) relative to IFBF estimates from herds across the state (grey).

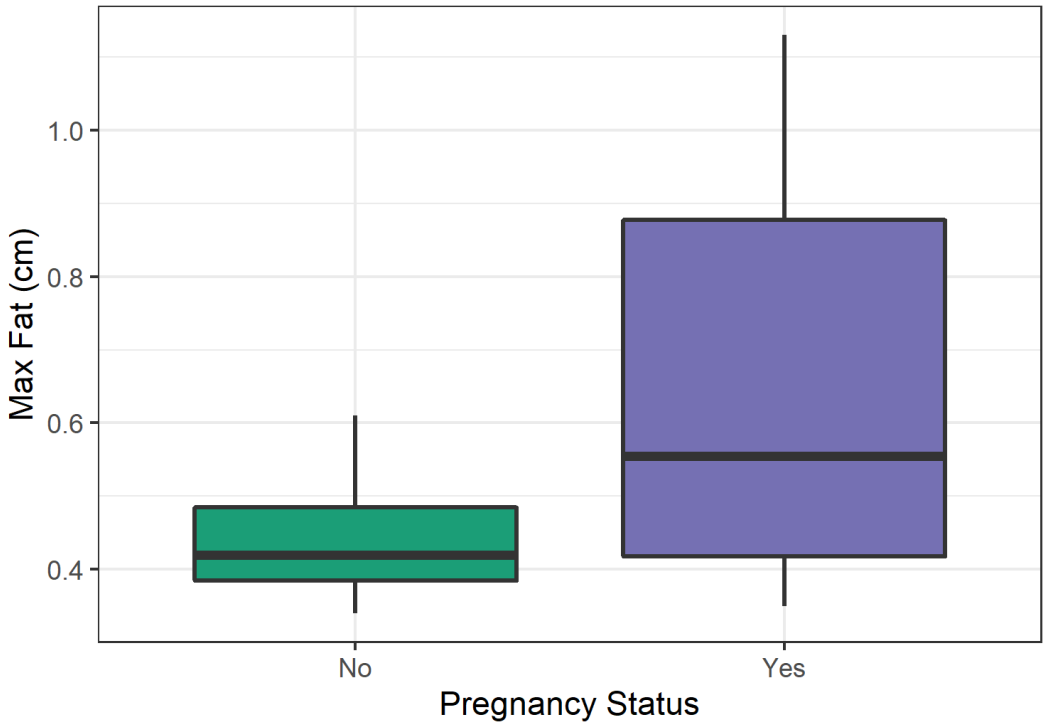

Figure 8. Max fat measurements (cm) of females classified as not pregnant/pregnant in the Custer study area in 2021.

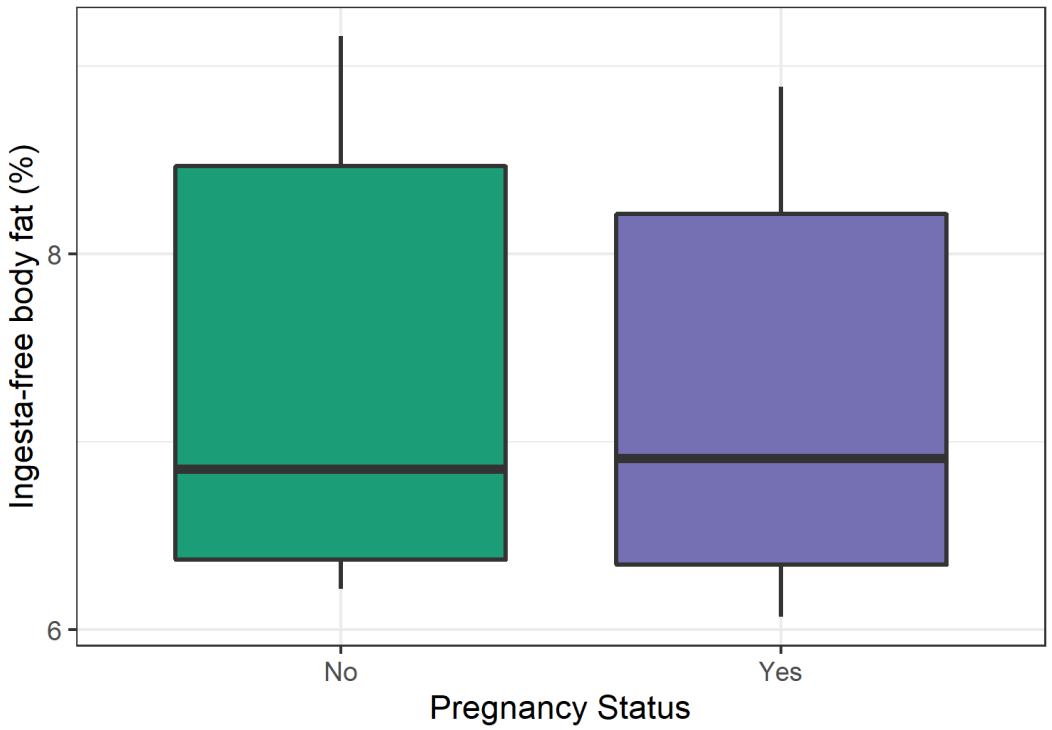

Figure 9. Estimated percent ingesta-free body fat (IFBF) of females classified as not pregnant/pregnant in the Custer study area in 2021.

Objective 2: Continue elk location data collection in the Devil's Kitchen study area and initiate location data collection in the Custer study area.

2.1 Devil's Kitchen Location and Movement Data Collection

As of August 1, 2021, we have gathered 572,385 locations from 65 individuals in the Devil's Kitchen study area for an average of 8,806 (range = 214 — 12,216) locations per individual. We have recovered collars from nine mortalities in the area; five were legally harvested during the 2020 hunting season, two were classified as natural mortalities, and two were classified as capture-related mortalities. An additional three collars have malfunctioned. We are currently monitoring 53 female elk in the area. Monthly reports have been generated and distributed to regional MFWP staff as well as other agency partners and private landowners. Preliminary estimates of seasonal ranges and movement corridors will be finalized when data collection is complete.

Preliminary movement data from the Devil's Kitchen area (Figure 10) has shown consistent seasonal movements in the spring and fall between the Beartooth Wildlife Management Area and private ranchlands in the valley bottom. We have also observed movement patterns that appear typical of resident animals dispersed throughout the study area. Individual elk land use in the Devil's Kitchen area shows high proportional use of private lands across all seasons, with an increase in proportional use of the Beartooth Wildlife Management Area in the winter and fall (Figure 11).

2.1.1 Devil's Kitchen Elk Locations and Movements

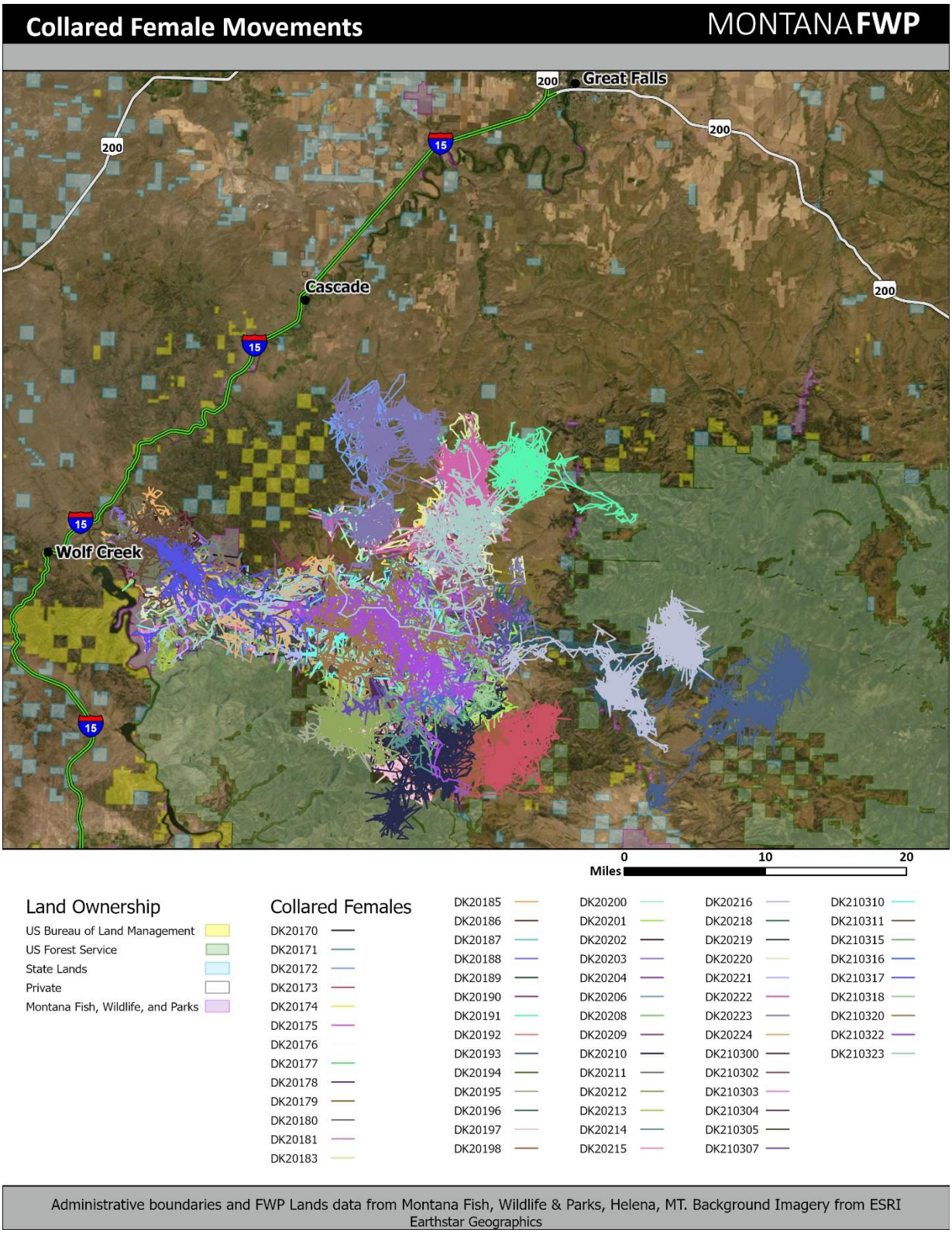

Figure 10. Movements of 65 collared individuals in the Devil's Kitchen study area through August 1, 2021.

2.1.2 Devil's Kitchen Elk Land Use

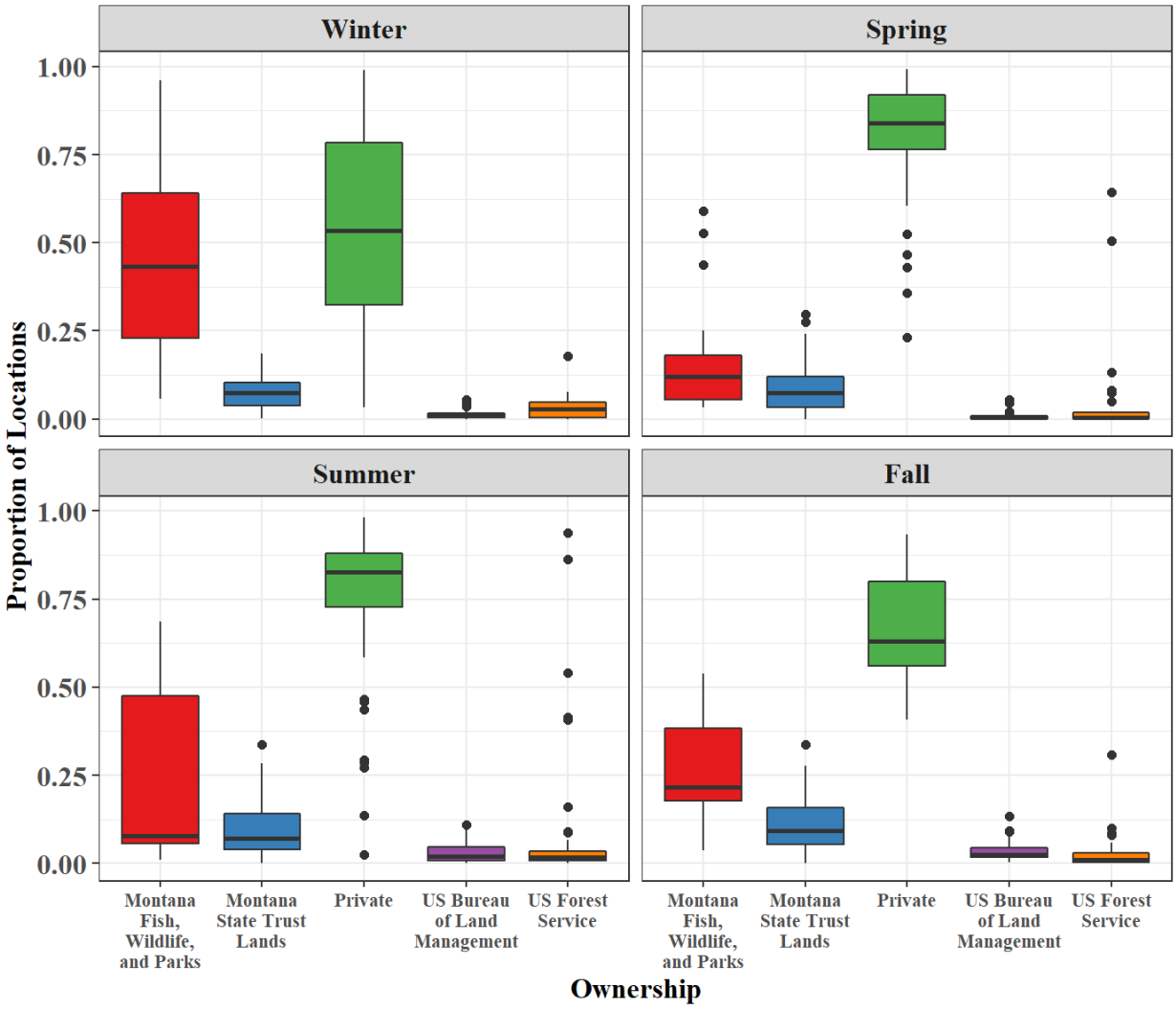

Figure 11. Proportional use of state, federal, and private lands by individual elk and season in the Devil's Kitchen study area. With the exception of some BLM lands that are accessible via helicopter, Montana State Trust and BLM lands in this study area are mostly inaccessible to the public.

2.2 Custer Elk Location and Movement Data Collection

As of August 1, 2021, we have gathered 188,013 locations from 60 individuals in the Custer study area for an average of 3,134 (range = 2,462—3,390) locations per individual. No collars have malfunctioned, no mortalities have occurred, and we are currently monitoring 60 individuals. Monthly reports have been generated and distributed to regional MFWP staff as well as other agency partners, private landowners, and the general public. Preliminary estimates of seasonal ranges and movement corridors will be compiled after a full year of data collection and will be finalized when data collection is complete. Current maps of male and female individual movements (Figures 12 & 13) and a summary of land use (Figure 14) can be found below.

We have observed a variety of individual movement patterns in both male and female collared elk. Most collared males have displayed relatively localized movements since capture, though one individual has travelled a linear distance of more than 50 miles (Figure 12). Three males have made forays across the border into Wyoming but returned to Montana shortly thereafter. Collared female movements have shown similar diversity, though on average have travelled a larger distance than males since capture (Figure 13). Some collared females began notable movements in mid-June. Two females have moved west onto the Crow Reservation near the I-90 corridor, and one individual moved east to loop into North Dakota before returning to its current location in the Ekalaka Hills in southeastern Montana. We have also observed female movements that looped south into Wyoming before returning to Montana. Most elk locations gathered thus far have occurred on either private lands or the Custer National Forest (Figure 14). The location data collected thus far indicates that individual patterns of proportional land use are similar across seasons.

2.2.1 Custer Elk Locations and Movements

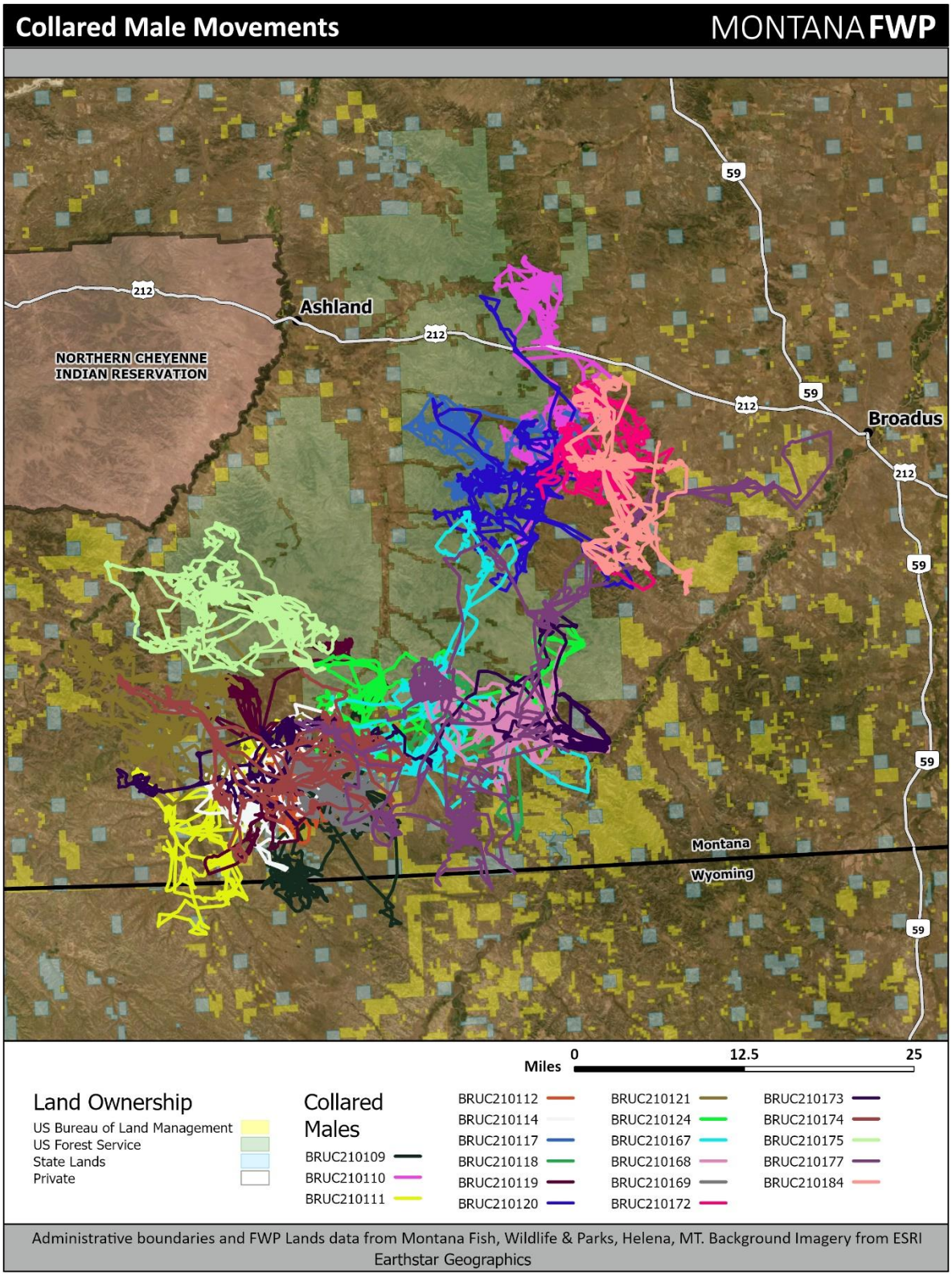

Figure 12. Movements of 20 collared bulls in the Custer study area through August 1, 2021.

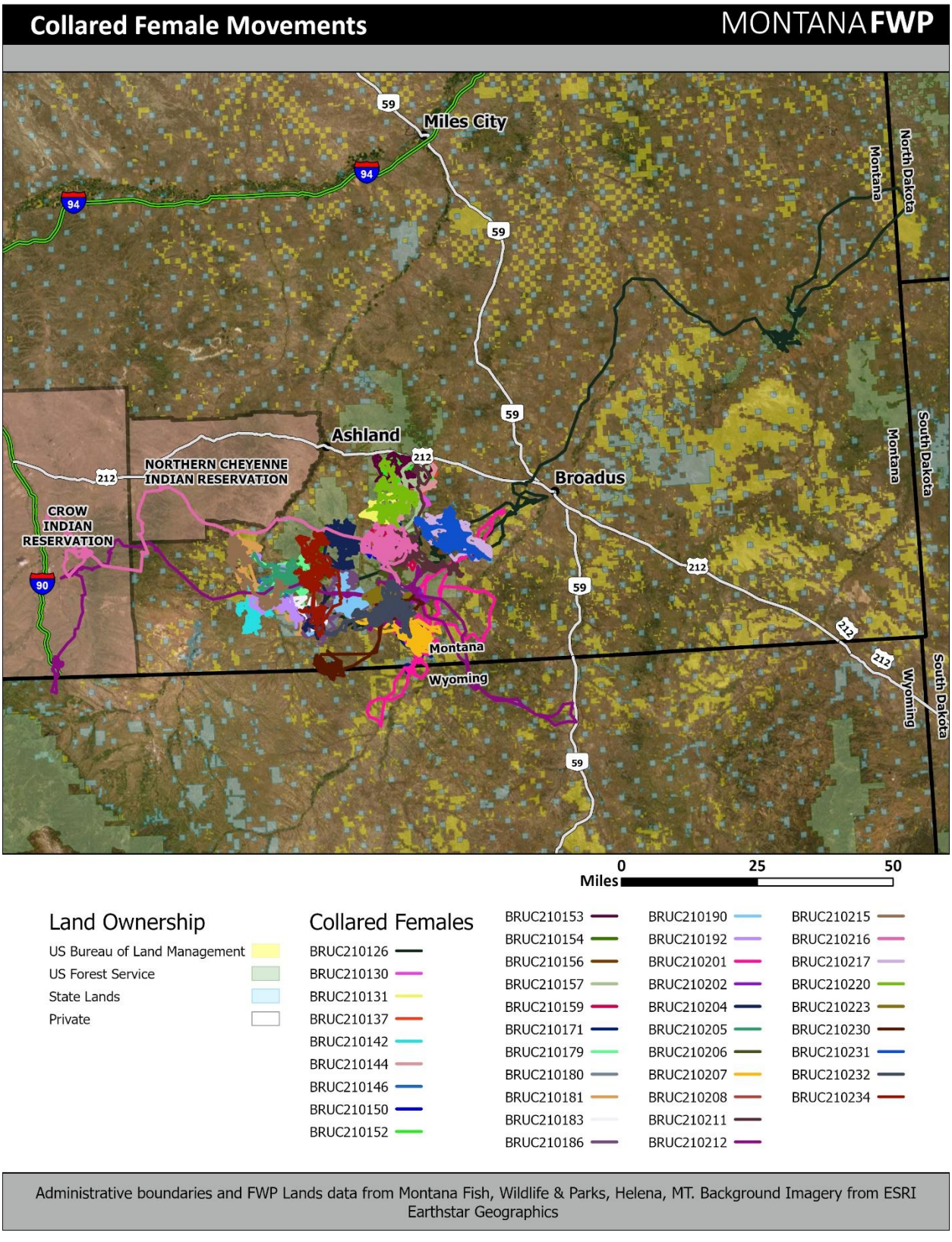

Figure 13. Movements of 40 collared cows in the Custer study area through August 1, 2021.

2.2.2 Custer Elk Land Use

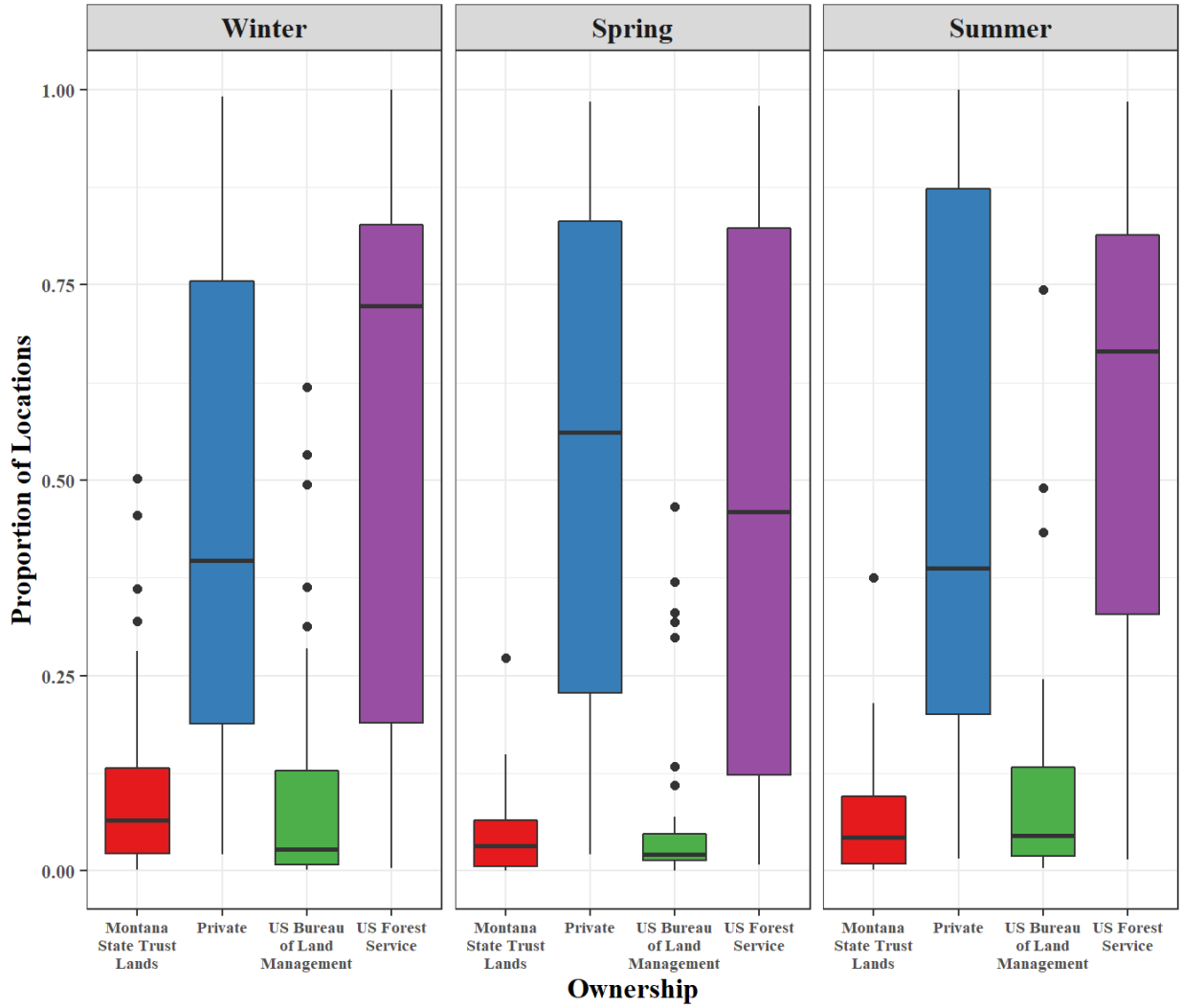

Figure 14. Proportional use of state, federal, and private lands by individual elk in the Custer study area by season.

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